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Lithostratigraphy and depositional environments of the Pyeongan Supergroup (Carboniferous–Permian) in the Taebaek area, mid-east Korea

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Abstract

The Pyeongan Supergroup (Carboniferous–Permian) consists of a thick siliciclastic sequence (1700 m thick). Recent sedimentological work in the Taebaek area has refined the lithostratigraphic units: Manhang, Geumcheon-Jangseong, Hambaeksan, Dosagok, Gohan and Donggo formations in ascending order. The entire sequence is represented by thirteen sedimentary facies, which can be organized into seven facies associations (FA). The lower part of the Manhang Formation (FA 1) (Moscovian) consists of crudely cross-stratified conglomerate, massive sandstone and gray homogeneous siltstone, formed in shoreface off river mouth, whereas purple siltstone and grainstone of the upper part (FA 2) probably formed in a coastal plain environment. The Geumcheon-Jangseong Formation (Moscovian-Artinskian) consists of dark gray sandstone, dark gray shale, coal and bioturbated wackestone (FA 3) formed in a lagoonal environment. The Hambaeksan Formation (Kungurian) comprises milky white, crudely stratified, conglomerate, gray coarse sandstone and partly laminated black shale (FA 4), representing a shoreface progradation. The Dosagok Formation (Late Permian) is characterized by an alternation of purple fine sandstone and conglomerate (FA 5), formed in a bedload-dominated fluvial system. The Gohan Formation (Late Permian) is mostly composed of upward-fining units (massive sandstone to dark gray siltstone) (FA 6), suggesting a restricted inter-distributary bay environment. The Donggo Formation (?Late Permian) consists of cross-stratified coarse sandstone and purple sandstone (FA 7), interpreted as deposits of perennial, sandy braided river system.

Keywords: Carboniferous; Permian; Pyeongan Supergroup; Depositional environments

1. Introduction

The Pyeongan Supergroup (Late Paleozoic) in the Taebaeksan Basin (Fig. 1), mid-east Korea, consists mainly of a thick (ca. 1700 m) siliciclastic sequence of conglomerate, sandstone, purple siltstone, and gray/black shale interlayered with coal and patchy limestone layers. It unconformably overlies the carbonate-siliciclastic sequence of the Joseon Supergroup (Early Paleozoic) (GICTR, 1962; Cheong, 1969). The entire sequence was highly deformed and moderately metamorphosed during tectonic events in the Mesozoic (Chough et al., 2000). The sequence contains abundant coal measures which have been extensively mined since the early 1950s. In spite of five decades of geological investigation, the Pyeongan Supergroup has not been properly studied for lithostratigraphy and sedimentary facies in measured sections.

The Pyeongan Supergroup was initially designated in the Taebaek area by Japanese workers and GICTR (1962) as the Hongjeom, Sadong, Gobangsan and Nogam series (formations), following the scheme of the Pyeongan System in the Pyeongnam Basin of North Korea (Table 1). The presently used scheme of stratigraphy was, however, established by Cheong (1969) based on fusulinids in discontinuous carbonate patches of subsurface (tunnel) sections, plant fossils and rock color: Manhang (equivalent to Hongjeom), Geumcheon (Sadong), Jangseong (Sadong), Hambaeksan (Gobangsan), Dosagok, Gohan and Donggo (the last three, equivalent to the Nogam) formations in

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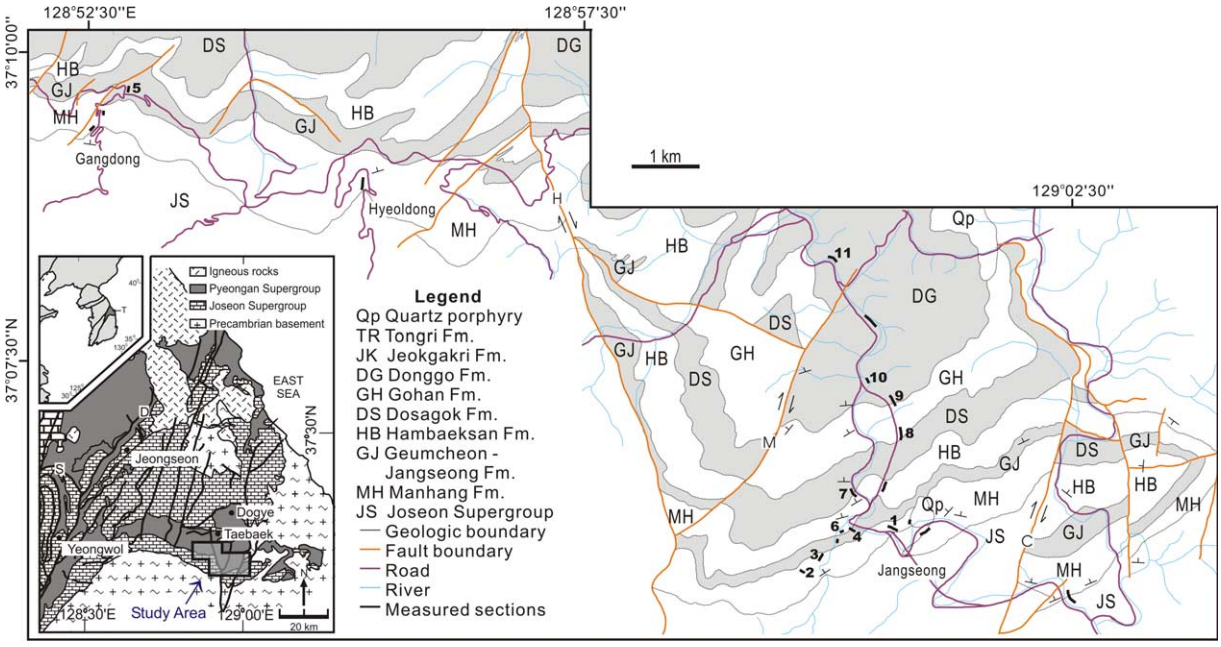

Fig. 1. Geologic map of the Pyeongan Supergroup. T, Taebaeksan Basin; S, Seonwol Fault; D, Deokpori Thrust Fault; H, Hambaeksan Fault; M, Mungok Fault; C, Cheolam Fault.

ascending order (Table 1). In surface outcrop sections, however, it was difficult to trace formation boundaries, especially the boundary between the Geumcheon and Jangseong formations, because of the lack of lithologic distinction. Cheong (1969) also assumed a parallel unconformity for the boundary between the Geumcheon and Jangseong formations (Table 1) based on fusulinid biostratigraphy in a few thin, discontinuous wackestone lenses. According to Cheong (1969), all lithologic boundaries correspond to chronostratigraphic boundaries (Table 1). This scheme was used by the subsequent workers for regional and local mapping and sampling for petrographic analysis (KIGAM, 1979; Kim et al., 1988; Kim et al., 1994; Lee and Lim, 1995).

This study presents detailed lithologic descriptions and sedimentary facies of available sections of the Pyeongan Supergroup in the Taebaek area. The detailed measurement provides fundamental basis for the lithologic correlation and the determination of formation boundaries. The sedimentary facies analysis allows interpretation of depositional processes and environments.

2. Regional geology and stratigraphy

2.1. Previous work

The Pyeongan Supergroup is well exposed in the Taebaek area, Gangwon Province, mideast Korea (Fig. 1). It is well manifested in the Baegunsan syncline, a large-scale N-S compressional deformation regime, where the entire Joseon and Pyeongan supergroups were folded and offset by NNE-SSW-running strike-slip faults, i.e. the Hambaeksan and Cheolam faults. An identical sequence occurs in the Pyeongnam Basin of north Korea where the coal-bearing upper Paleozoic sequence was named the Pyeongan System (Kodaira, 1924). Kawasaki (1927) divided the Pyeongan System into four units: Hongjeom Formation, Sadong Formation, Gobangsan Series, and Nogsaegam Formation in ascending order, based on rock color and plant fossil assemblages. Tateiwa (1931) used 'series' instead of 'formation' in order to confirm the Pyeongan System (Table 1). The stratigraphic framework of the Pyeongnam Basin was applied to the Taebaeksan Basin (Shiraki, 1930; 1940). Geological Investigation Corps of Taebaegsan Region (GICTR, 1962) mapped the entire sequence (scale of 1:50,000, 17 sheets) for the purpose of exploration of coal and limestone. GICTR (1962) placed the lower boundary of the Sadong Series at the base of the Permian, and the lower boundary of the Gobangsan Series at the base of the Triassic. Table 1 shows the modified chronostratigraphic units.

Cheong (1969) pointed out that the nomenclature of the Pyeongan System should not be applied to the lithologic units in the Taebaek area, because it is difficult to access the type locality and stratotype of the Pyeongan System. Cheong (1969) refined the stratigraphy and fossil assemblages in the Taebaek area and divided the Pyeongan Supergroup into three groups and seven formations: Manhang and Geumcheon formations were placed in Gomog Group; Jangseong and Hambaeksan formations in Cheolam Group; and Dosagok, Gohan and Donggo formations in Hwangji Group (Table 1). However, these units were lithologically poorly defined due to the lack of detailed columnar descriptions, low precision of age-dating